

**CLAIMS**

1    1.    A method of forming an aluminum-comprising physical vapor deposition  
2    target, comprising:

3                 deforming an aluminum-comprising mass by equal channel angular  
4                 extrusion, wherein the mass is at least 99.99% aluminum and further  
5                 comprises less than or equal to about 1000 ppm of one or more dopant  
6                 materials comprising elements selected from the group consisting of Ac, Ag,  
7                 As, B, Ba, Be, Bi, C, Ca, Cd, Ce, Co, Cr, Cu, Dy, Er, Eu, Fe, Ga, Gd, Ge, Hf,  
8                 Ho, In, Ir, La, Lu, Mg, Mn, Mo, N, Nb, Nd, Ni, O, Os, P, Pb, Pd, Pm, Po, Pr,  
9                 Pt, Pu, Ra, Rf, Rh, Ru, S, Sb, Sc, Se, Si, Sm, Sn, Sr, Ta, Tb, Te, Ti, Tl, Tm,  
10                 V, W, Y, Yb, Zn and Zr;

11                 after the deforming, shaping the mass into at least a portion of a physical  
12                 vapor deposition target.

1    2.    The method of claim 1 wherein the physical vapor deposition target is a  
2    monolithic target.

1    3.    The method of claim 1 wherein the one or more dopant materials comprise  
2    materials selected from the group consisting of B, Ba, Be, Ca, Ce, Co, Cr, Dy, Er,  
3    Eu, Gd, Ge, Hf, Ho, La, Ni, Nd, Pd, Pm, Pr, Sb, Sc, Si, Sm, Sr, Tb, Te, Ti, Tm, Y,  
4    Yb and Zr.

1    4.    The method of claim 1 wherein the one or more dopant materials comprise  
2    materials selected from the group consisting of Si, Sc, Ti and Hf.

1    5.    The method of claim 1 wherein the mass consists of aluminum and from  
2    about 10 ppm to about 100 ppm of the one or more dopant elements.

1       6.       The method of claim 1 wherein the mass consists of Al and from about 10  
2       ppm to about 100 ppm of one or more of Si, Sc, Ti, and Hf.

1       7.       The method of claim 1 wherein the mass consists of Al and from about 10  
2       ppm to about 100 ppm of Hf.

1       8.       The method of claim 1 wherein the mass consists of Al and from about 10  
2       ppm to about 100 ppm of Ti.

1       9.       The method of claim 1 wherein the mass consists of Al and from about 10  
2       ppm to about 100 ppm of Sc.

1       10.      The method of claim 1 wherein the mass consists of Al and from about 10  
2       ppm to about 100 ppm of Si.

1       11.      A method of forming an aluminum-comprising physical vapor deposition  
2       target, comprising:  
3                  deforming an aluminum-comprising mass by equal channel angular  
4                  extrusion; and  
5                  after the deforming, shaping the mass into at least a portion of a physical  
6                  vapor deposition target, the physical vapor deposition target having an  
7                  average grain size less than or equal to 45 microns.

1       12.      The method of claim 11 wherein the mass is formed into an entirety of the  
2       physical vapor deposition target, and further comprising mounting the mass to a  
3       backing plate.

1    13.     The method of claim 11 wherein the mass is at least 99.99% aluminum and  
2        consists of Al and less than 100 ppm of one or more of Si, Sc, Ti and Hf.

1    14.     The method of claim 11 wherein the mass is at least 99.99% aluminum, and  
2        further comprises greater than 0 ppm and less than or equal to about 100 ppm of  
3        one or more dopant materials comprising elements selected from the group  
4        consisting of Ac, Ag, As, B, Ba, Be, Bi, C, Ca, Cd, Ce, Co, Cr, Cu, Dy, Er, Eu, Fe,  
5        Ga, Gd, Ge, Hf, Ho, In, Ir, La, Lu, Mg, Mn, Mo, N, Nb, Nd, Ni, O, Os, P, Pb, Pd,  
6        Pm, Po, Pr, Pt, Pu, Ra, Rf, Rh, Ru, S, Sb, Sc, Se, Si, Sm, Sn, Sr, Ta, Tb, Te, Ti, Tl,  
7        Tm, V, W, Y, Yb, Zn and Zr.

1    15.     The method of claim 11 wherein the mass consists essentially of aluminum.

1    16.     The method of claim 11 wherein the mass consists essentially of aluminum,  
2        and less than or equal to about 100 ppm of one or more dopant materials  
3        comprising elements selected from the group consisting of Ac, Ag, As, B, Ba, Be,  
4        Bi, C, Ca, Cd, Ce, Co, Cr, Cu, Dy, Er, Eu, Fe, Ga, Gd, Ge, Hf, Ho, In, Ir, La, Lu,  
5        Mg, Mn, Mo, N, Nb, Nd, Ni, O, Os, P, Pb, Pd, Pm, Po, Pr, Pt, Pu, Ra, Rf, Rh, Ru,  
6        S, Sb, Sc, Se, Si, Sm, Sn, Sr, Ta, Tb, Te, Ti, Tl, Tm, V, W, Y, Yb, Zn and Zr.

1    17.     The method of claim 11 wherein the shaping comprises one or more of  
2        forging and rolling of the aluminum-comprising mass at a temperature of less than  
3        or equal to about 200°C.

1    18.     The method of claim 11 wherein the deforming comprises at least three  
2        extruding steps, each of the at least three extruding steps comprising passing the  
3        mass through two intersecting passages having approximately equal cross-sections.

- 1    19.     The method of claim 11 wherein the deforming comprises at least four  
2       extruding steps, each of the at least four extruding steps comprising passing the  
3       mass through two intersecting passages having approximately equal cross-sections.
- 1    20.     The method of claim 11 wherein the deforming comprises at least six  
2       extruding steps, each of the at least six extruding steps comprising passing the  
3       mass through two intersecting passages having approximately equal cross-sections.
- 1    21.     A physical vapor deposition target consisting essentially of aluminum and  
2       less than or equal to 1000 ppm of one or more dopant materials comprising  
3       elements selected from the group consisting of Ac, Ag, As, B, Ba, Be, Bi, C, Ca,  
4       Cd, Ce, Co, Cr, Cu, Dy, Er, Eu, Fe, Ga, Gd, Ge, Hf, Ho, In, Ir, La, Lu, Mg, Mn,  
5       Mo, N, Nb, Nd, Ni, O, Os, P, Pb, Pd, Pm, Po, Pr, Pt, Pu, Ra, Rf, Rh, Ru, S, Sb, Sc,  
6       Se, Si, Sm, Sn, Sr, Ta, Tb, Te, Ti, Tl, Tm, V, W, Y, Yb, Zn and Zr; the physical  
7       vapor deposition target having an average grain size of less than 100 microns.
- 1    22.     The physical vapor deposition target of claim 21 having an average grain size  
2       of less than or equal to 45 microns.
- 1    23.     The physical vapor deposition target of claim 21 consisting of Al and less  
2       than 100 ppm of one or more of Si, Sc, Ti; and Hf.
- 1    24.     The physical vapor deposition target of claim 21 consisting of Al and from  
2       10 ppm to 100 ppm of one or more of Si, Sc, Ti; and Hf.

1    25.     The physical vapor deposition target of claim 21 consisting of Al and from  
2        10 ppm to 100 ppm of Sc; the target having an average grain size of less than or  
3        equal to 45 microns.

1    26.     The physical vapor deposition target of claim 21 consisting of Al and from  
2        10 ppm to 100 ppm of Si; the target having an average grain size of less than or  
3        equal to 35 microns.

1    27.     The physical vapor deposition target of claim 21 consisting of Al and from  
2        10 ppm to 100 ppm of Ti.

1    28.     The physical vapor deposition target of claim 21 consisting of Al and from  
2        10 ppm to 100 ppm of Hf.

1    29.     A film sputtered from a target, the film consisting essentially of aluminum  
2        and less than or equal to 1000 ppm of one or more dopant materials comprising  
3        elements selected from the group consisting of Ac, Ag, As, B, Ba, Be, Bi, C, Ca,  
4        Cd, Ce, Co, Cr, Cu, Dy, Er, Eu, Fe, Ga, Gd, Ge, Hf, Ho, In, Ir, La, Lu, Mg, Mn,  
5        Mo, N, Nb, Nd, Ni, O, Os, P, Pb, Pd, Pm, Po, Pr, Pt, Pu, Ra, Rf, Rh, Ru, S, Sb, Sc,  
6        Se, Si, Sm, Sn, Sr, Ta, Tb, Te, Ti, Tl, Tm, V, W, Y, Yb, Zn and Zr.

1    30.     The film of claim 29 consisting of Al and less than 100 ppm of one or more  
2        of Si, Sc, Ti and Hf.

1    31.     The film of claim 29 consisting of Al and from 10 ppm to 100 ppm of one or  
2        more of Si, Sc, Ti and Hf.